

09-2209

AF/2823
JFW
A

Application No. 09/679,514

TSMC-00-166
N1085-90069



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

I hereby certify that this document (and any documents referred to therein) is being deposited with the United States Postal Service on the date shown below with sufficient postage as Express Mail EV 275663785 US in an envelope addressed to: Mail Stop AF, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on September 20, 2004.

Maria E. Provencio
Signature

Maria E. Provencio
Printed Name

Applicant : Hung-Jen Hsu
Application No. : 09/679,514
Filed : October 6, 2000
Title : A METHOD TO IMPROVE PASSIVATION
OPENINGS BY REFLOW OF PHOTORESIST TO
ELIMINATE TAPE RESIDUE

Grp./Div. : 2823
Examiner : B. Kebede

Docket No. : N1085-90069

APPELLANTS' BRIEF

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Duane Morris LLP
101 West Broadway, Suite 900
San Diego, CA 92101
September 20, 2004

Commissioner:

1. REAL PARTY IN INTEREST

The real party in interest is Taiwan Semiconductor Manufacturing Company, Ltd. The rights to this application were originally assigned to Taiwan Semiconductor Manufacturing Company, Ltd., and that assignment recorded at

5 Reel 011228/Frame 0408.

2. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the present appeal, that are known to Appellants or Appellants' attorney.

5 3. STATUS OF CLAIMS

Claims 1-20 are pending in this application. Claims 1-20 have been rejected. The rejection of each of claims 1-20 are hereby appealed.

4. STATUS OF AMENDMENTS AFTER FINAL REJECTION

10 No amendments were filed after the final Office action of January 21, 2004. A response to the final Office action was filed on March 22, 2004 and included the Appellants' arguments, but did not include claim amendments.

5. SUMMARY OF INVENTION

15 The present invention provides a method for backgrinding a semiconductor substrate using a protective adhesive tape that is easily removed without leaving a residue. Backgrinding is a backside grinding operation performed on the backside of a substrate, the front side of which includes semiconductor devices. Semiconductor devices are formed on the substrate to include passivation layer openings, i.e. bond pad openings, that include gradually sloping sidewalls. A protective adhesive tape is formed over the semiconductor
20 device such that the backside of the semiconductor substrate can undergo a backside grinding operation with the protective tape in place. The tapered profile of the bond pad opening allows the adhesive/protective tape to be removed after the backgrinding operation without any adhesive remaining on the semiconductor device. In particular, the invention prevents residual adhesive in the bond pad area due to sharp edges of the bond pad. The gradually sloping sidewalls of the
25 passivation openings are formed by reflowing an organic photoresist masking layer to create gradually sloping sidewalls in the masking layer which are then translated to the gradually sloping sidewalls of the passivation/bond pad openings by etching.

The invention is described generally in the specification from page 6, line 7 through page 15.

6. ISSUES PRESENTED

5 The issues presented are whether the Examiner properly rejected the claims in the January 21, 2004 Office action.

The first issue presented is whether or not the Examiner properly rejected claims 1-15 under 35 USC § 103(a) as being unpatentable over Tsuji, et al. (JP/05160019) in view of applicants' admitted prior art (Figs. 1-4 and description of the prior art pages 1-6).

10 The second issue presented is whether or not the Examiner properly rejected claims 16 -20 under 35 USC § 103(a) as being unpatentable over applicants' admitted prior art (Figs. 1-4) in view of over Tsuji, et al. (JP/05160019).

7. GROUPING OF CLAIMS

15 The claims of this application do not stand and fall together. There are three independent claims in this application, claims 1, 9 and 16. Claims 2-8 depend from claim 1, claims 10-15 depend from claim 9, and claims 17-20 depend from claim 16. The claims can therefore be divided into two groups:

Group I: Claims 1-8 are presented as standing together;

20 Group II: Claims 9-15 are presented as standing together and separately from the claims of Group I.

Group III: Claims 16-20 are presented as standing together and separately from the claims of Groups I and II.

The complete claim set is included in the Appendix (Section 9).

8. ARGUMENT**8A. Final Rejection of Claims 1-20.**

In the final Office action dated January 21, 2004, claims 1-20 of the present application were rejected under 35 U.S.C. § 103(a).

5 In particular, the Examiner rejected claims 1-15 under 35 U.S.C. § 103(a) as being unpatentable over Tsuji, et al (JP/05160019) in view of admitted prior art (AAPA). The Examiner also rejected claims 16-20 35 U.S.C. § 103(a) as being unpatentable over applicants' admitted prior art (Figs. 1-4) in view of Tsuji, et al (JP/05160019). The Examiner's previous rejections from the August 8,
10 2003 office action were merely maintained and repeated.

The final Office action of January 21, 2004 also included the Examiner's comments regarding previously filed arguments included in a Response filed by the Appellants on November 12, 2003. The November 12, 2003 Response was filed responsive to an Office action dated August 8, 2003.

15 On March 22, 2004, Appellants filed a Response to the final Office action of January 21, 2004. The March 22, 2004 Response did not include any claim amendments.

8B. Claims 1-15 Are Not Subject To Rejection Under 35 U.S.C. § 103

20 Claims 1-15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tsuji, et al. (JP/05160019), hereinafter "Tsuji", in view of applicants' admitted prior art (Figs. 1-4 and description of the prior art pages 1-6), hereinafter AAPA. Appellants respectfully submit that the rejection of claims 1-15 under 35 U.S.C. § 103(a) should be reversed for reasons set forth below.

25 As a preliminary observation, it should be noted that each of independent method claims 1 and 9 recite a combination of limitations, some of which may be known separately. It is the new combination of these limitations which is claimed and which is non-obvious under the conditions of 35 U.S.C. § 103. It is because
30 of the combination of the limitations that the Appellants' claimed invention achieves advantages that were unachievable in the prior art. Moreover, each of

claims 1 and 9 include significant limitations other than the separately known limitations. It is respectfully submitted that claims 1 and 9 are patentable because there was no apparent suggestion or motivation to combine Tsuji and the AAPA to solve the problem addressed by the applicant at the time of the
5 applicants' invention.

The PTO has the burden under § 103 to establish a prima-facie case of obviousness *In re: Fine*, 5 USPQ 1596, 1598 (Fed. Cir. 1988). When an obviousness determination depends on a selective combination of prior art references, there must be some reason for the combination other than hindsight
10 gleaned from the invention itself. The prior art under consideration must contain the teaching or motivation or incentive or suggestion to do so. Appellants respectfully submit that the PTO has not upheld this burden because there is no motivation in the prior art to combine the references.

Tsuji describes a method to reduce back-sputtering during a dry etching
15 operation. The method includes shaping the sidewalls of a patterned photoresist film. Tsuji is directed to creating an optimal profile of photoresist so that when the photoresist is used as a mask for sputter etching an underlying layer, photoresist by-products are not produced and do not back-sputter onto the sides of the photoresist film or the opening being formed. In fact, Tsuji finds particular
20 application in smaller openings formed earlier in the device fabrication sequence and in which such back-sputtering problems could contaminate small contact openings and cause failure. In contrast, the extremely large bond pad openings of the Appellants' invention are rather insensitive to such effects because of their comparatively large size and represent the final fabrication step prior to
25 backgrinding. Tsuji does not teach or suggest a motivation to add steps useful for backgrinding and Tsuji does not teach or suggest a motivation to add steps including forming a tape over an etched dielectric layer. It would not be obvious to place a protective adhesive tape over Tsuji's structure nor would it be obvious to carry out a backgrinding operation immediately following the formation of the
30 openings in Tsuji. The art of backgrinding is not analogous to the art of sputter etching, especially the sputter etching of small openings.

Tsuji appears unrelated to applicant's claimed invention. Tsuji is not even directed to creating an optimal profile for the etched film but, rather, is only concerned with the profile of the photoresist layer. Tsuji does not discuss the profile of the etched subjacent film or advantages of having a sloped sidewall in the etched film. Appellants respectfully submit that one of ordinary skill in the art at the time of the invention would not be motivated to combine a method for reducing back-sputtering in lower levels of the semiconductor device with a backside grinding process.

The AAPA provides that a protective adhesive tape is used in the backgrinding process, but does not teach or suggest using a method of modifying the sidewall profile of patterned photoresist to achieve an optimal passivation opening sidewall profile nor that such a profile would be advantageous in a backgrinding operation. Independent claims 1 and 9 of Appellants' invention enable and recite the feature of forming "passivation openings with gradually sloping sidewalls". It is this feature that allows the protective tape to be removed without leaving residue.

It is the combination of the features of (1) etching the passivation layer to form passivation openings with gradually sloping sidewalls; and (2) applying a protective tape for a backgrinding operation, that enables the protective tape to be completely removed without leaving adhesive residue and which is not taught or suggested in the prior art. For reasons set forth above, it would not be obvious and there would be no motivation to combine these references from non-analogous art.

Therefore, the Examiner's rejection of claims 1 and 9 under 35 U.S.C. § 103(a) as unpatentable over Tsuji in view of AAPA, should be reversed. Claims 2-8 and 10-15 recite patentable distinct further limitations on claims 1 and 9 respectively and therefore the Examiner's rejection of 2-8 and 10-15 under 35 U.S.C. under § 103(a) as being unpatentable over Tsuji in view of AAPA, should also be reversed.

8C. Claims 16-20 Are Not Subject To Rejection Under 35 U.S.C. § 103

5 Claims 16-20 stand rejected under 35 U.S.C. § 103(a) as being unpatenable over applicants' admitted prior art (Figs. 1-4 and description of the prior art pages 1-6) in view of Tsuji, et al. (JP/05160019). Appellants respectfully submit that the rejection of claims 16-20 under 35 U.S.C. § 103(a) should be reversed for reasons set forth below.

10 Claim 16 is a method claim that recites the features of "reflowing said organic photoresist layer", "to form said bond pad openings with gradually sloping sidewalls", "applying a protective tape" and "removing said protective tape wherein said gradually sloping sidewalls on said passivation openings allow the protective tape to be completely removed without leaving adhesive residue".

15 As a preliminary observation, it should be noted that independent claim 16 recites a combination of limitations, some of which may be known separately. It is the new combination of these limitations which is claimed and which is non-obvious under the conditions of 35 U.S.C. § 103. It is because of the combination of the limitations that the Appellants' claimed invention achieves advantages that were unachievable in the prior art. Moreover, claim 16 includes significant limitations other than the known limitations. It is respectfully submitted
20 that claim 16 is patentable because there was no apparent suggestion or motivation to combine the AAPA and Tsuji to solve the problem addressed by the Appellants at the time of the Appellants' invention.

25 Appellants admitted prior art is directed to backgrinding techniques including the formation of a protective tape over the front side of the substrate prior to the backgrinding operation, and removing the protective tape after the backside grinding operation. The AAPA does not teach or suggest using a method of modifying the sidewall profile of a patterned photoresist masking layer to achieve an optimal passivation sidewall profile. As above, Tsuji is directed to prevent back-sputtering during an etching operation by creating a sloped profile
30 in a photoresist masking layer to reduce contamination in contact openings that are sensitive to such contaminants, i.e., contact openings formed early in the device fabrication sequence – not bond pads openings. Appellants respectfully

submit that it would not have been obvious to one of ordinary skill in the art at the time of the Appellants invention, to combine the teachings of a backside grinding technique with a method for reducing back-sputtering during an etching operation performed early in the process sequence. The art of backgrinding is not analogous to the art of etching small openings using tapered photoresist to prevent back-sputtering.

Therefore, Appellants respectfully submit that it would not have been obvious to one of ordinary skill in the art at the time of the Appellants claimed invention was made to combine the AAPA with Tsuji. Therefore the Examiner's rejection of claim 16 under 35 U.S.C. § 103(a) as being unpatentable over the AAPA (Figs. 1-4) in view of over Tsuji should be reversed. Claims 17-20 depend from independent claim 16 and each provide patentably distinct further limitations on claim 16 and therefore the rejection of claims 17-20 under 35 U.S.C. § 103(a) should also be reversed.

8D. Conclusion.

In view of the foregoing remarks, Appellants submit that this application is in condition for allowance. Appellants respectfully request that the Board reverse the Examiner's rejection of all pending claims.

In accordance with 37 CFR §1.192(a), this Appeal Brief is being submitted in triplicate. Also enclosed is the fee for filing an Appeal Brief under 37 CFR §1.17(c) in the amount of \$330.

Respectfully submitted,

DUANE MORRIS LLP

By 
Mark J. Marcelli, Reg. No. 36,593
619/744-2243

Attachments: Appendix

9. APPENDIX**Claims Under Appeal**

1. (Previously Presented) A method to form passivation openings that prevent protective tape residue in the manufacture of an integrated circuit device comprising:
 - providing a semiconductor substrate;
 - depositing a passivation layer overlying said semiconductor substrate;
 - depositing an organic photoresist layer overlying said passivation layer;
 - patterning said organic photoresist layer to expose said passivation layer in areas where said passivation openings are planned;
 - reflowing said organic photoresist layer to create gradually sloping sidewalls on said organic photoresist layer;
 - thereafter etching through said passivation layer not covered by organic photoresist layer to form said passivation openings with gradually sloping sidewalls wherein said etching does not etch said organic photoresist layer;
 - stripping away said organic photoresist layer;
 - applying a protective tape overlying said passivation layer and said passivation openings; and
 - removing said protective tape wherein said gradually sloping sidewalls on said passivation openings allow said protective tape to be completely removed without leaving adhesive residue in the manufacture of the integrated circuit device.
2. (Original) The method according to Claim 1 wherein said passivation layer comprises silicon nitride.
3. (Original) The method according to Claim 1 wherein said passivation layer is deposited to a thickness of between about 3,000 Angstroms and 15,000 Angstroms.
4. (Original) The method according to Claim 1 wherein said organic photoresist layer is deposited to a thickness of between about 10,000 Angstroms and 50,000 Angstroms.
5. (Original) The method according to Claim 1 wherein said step of reflowing said organic photoresist layer is performed at a temperature of between about 140 degrees C and 200 degrees C for a duration of between about 3 minutes and 15 minutes.

6. (Original) The method according to Claim 1 wherein said step of etching through said passivation layer comprises a dry plasma etching process using an etching chemistry comprising CF_4 and O_2 gases.
7. (Original) The method according to Claim 1 wherein said step of removing said protective tape is by use of a peeling tape.
8. (Original) The method according to Claim 1 further comprising grinding the backside of said semiconductor substrate after said step of applying said protective tape and prior to said step of removing said protective tape.
9. (Previously Presented) A method to form bonding pad openings that prevent tape residue in the manufacture of an integrated circuit device comprising:
 - providing a semiconductor substrate;
 - depositing a passivation layer overlying said semiconductor substrate;
 - depositing an organic photoresist layer overlying said passivation layer;
 - patterning said organic photoresist layer to expose said passivation layer in areas where passivation openings are planned;
 - reflowing said organic photoresist layer to create gradually sloping sidewalls on said organic photoresist layer wherein said reflowing is performed at a temperature of between 140 degrees C and 210 degrees C for a duration of between 3 minutes and 15 minutes;
 - etching through said passivation layer not covered by said organic photoresist layer to form said passivation openings with gradually sloping sidewalls;
 - stripping away said organic photoresist layer;
 - applying a protective tape overlying said passivation layer and said passivation openings; and
 - removing said protective tape wherein said gradually sloping sidewalls on said passivation openings allow the protective tape to be completely removed without leaving adhesive residue.
10. (Original) The method according to Claim 9 wherein said passivation layer comprises silicon nitride.

11. (Original) The method according to Claim 9 wherein said passivation layer is deposited to a thickness of between about 3,000 Angstroms and 15,000 Angstroms.
12. (Original) The method according to Claim 9 wherein said organic photoresist layer is deposited to a thickness of between about 10,000 Angstroms and 50,000 Angstroms.
13. (Previously Presented) The method according to Claim 9 wherein said step of removing said protective tape is by use of a peeling tape.
14. (Original) The method according to Claim 9 wherein said step of etching through said passivation layer comprises a dry plasma etching process using an etching chemistry comprising CF_4 and O_2 gases.
15. (Original) The method according to Claim 9 further comprising grinding the backside of said semiconductor substrate after said step of applying said protective tape and prior to said step of removing said protective tape.
16. (Previously Presented) A method to form bonding pad openings that prevent tape residue in the manufacture of an integrated circuit device comprising:
 - providing a semiconductor substrate;
 - providing a metal layer overlying said semiconductor substrate;
 - depositing a passivation layer overlying said metal layer;
 - depositing an organic photoresist layer overlying said passivation layer;
 - patterning said organic photoresist layer to expose said passivation layer in areas overlying said metal layer where said bonding pad openings are planned;
 - reflowing said organic photoresist layer to create gradually sloping sidewalls on said organic photoresist layer wherein said reflowing is performed at a temperature of between 140 degrees C and 200 degrees C for a duration of between 3 minutes and 15 minutes;
 - etching through said passivation layer not covered by said passivation layer to form said bond pad openings with gradually sloping sidewalls;
 - stripping away said organic photoresist layer;
 - applying a protective tape overlying said passivation layer and said bond pad openings; and

removing said protective tape wherein said gradually sloping sidewalls on said passivation openings allow the protective tape to be completely removed without leaving adhesive residue and wherein said removing is by use of a peeling tape in the manufacture of the integrated circuit device.

17. (Original) The method according to Claim 16 wherein said passivation layer is deposited to a thickness of between about 3,000 Angstroms and 15,000 Angstroms.

18. (Original) The method according to Claim 16 wherein said organic photoresist layer is deposited to a thickness or between about 10,000 Angstroms and 50,000 Angstroms.

19. (Previously Presented) The method according to Claim 15 further comprising grinding the backside of said semiconductor substrate after said step of applying a protective tape and prior to said step of removing said protective tape.

20. (Original) The method according to Claim 16 wherein said step of etching through said passivation layer comprises a dry plasma etching process using an etching chemistry comprising CF_4 and O_2 gases.

MJM/mep